Claims

1. Method for the evaluating the operating conditions of a machine (1) or an installation, for which at least one parameter is measured a number of times, to create a database (6), which comprises values $(x_1, y_1) \dots (x_n \dots y_n)$ of the parameter, with a measure of quality (K) of an extrapolation being calculated on the basis of the database (6), with which the measure of quality (K) is a function of at least two variables of the group V, ΔI, S, C, with (V) being a ratio of the value range of the database (6) to the extrapolation range xs, which is determined by $x_s > x1, x_n$, with (ΔI) being the x uncertainty of the adjustment curve (21) in the x direction, with (S) being continuity as a measure of the change in the y values in the database (6) and (c) being the time constancy of the extrapolation.

2. Method according to Claim 1, characterized in that the evaluation of the operating conditions is used to influence the parameter accordingly based on the measure of quality (K).

3. Method according to Claim 1 or 2, characterized in that the evaluation of the operating conditions increases the operational dependability of the machine (1) or the installation, by influencing the parameter accordingly based on the measure of quality (K).

4. Method according to Claim 1 or 2, characterized in that the evaluation of the operating conditions is used to optimize the operation of the machine (1) or the installation.

5. Method according to Claim 3, characterized in that a limit value (18) is predetermined for the parameter and a period is determined in which the limit value (18) of the parameter is not exceeded.

6. Method according to Claim 1, characterized in that the variables are selected so that the measure of quality (K) does not depend on the gradient of an adjustment curve in respect of the database (6)

7. Method according to Claim 1, characterized in that the measure of quality (K) is standardized, in particular by $1\text{-}e^{-K}$.

8. Method according to Claim 7, characterized in that

the measure of quality (K) is standardized to a value range of 0 to 100%.

9. Method according to Claim 1, characterized in that the measure of quality (K) is defined by:

$$K = \frac{V * \Delta I}{S * C}.$$

10. Method according to Claim 1 or 9, characterized in that the ratio (V) of the value range of the database (6) is defined by $(X_n - X_1)/(X_S - X_1)$.

11. Method according to Claim 1, characterized in that the database (6) is divided into at least three segments (45, 48, 52); a mean value g_1, g_2, g_3 and a linear adjustment function y_1, y_2, y_3 (36, 39, 42) with gradients c_1, c_2 and c_3 are each calculated for each segment (45, 48, 52) from the database (6); a numerical curvature measure p

$p = g_1 - 2*g_2 + g_3$

is calculated, which reflects the current direction of curvature of the gradient pattern; from a curve repertoire of curve types at least of the group:

Linear function	-> $f(x) = y = a_0 + a_1*x$
Potency function	-> $f(x) = \ln y = \ln a_0 + a_1*\ln x$
Logarithmic function	-> $f(x) = y = a_0 + a_1*\ln x$
Exponential function	-> $f(x) = \ln y = \ln a_0 + a_1 x$

that curve type of the adjustment function is selected iteratively and adjusted in respect of the value range of the entire current database (6),

with the curve type selected from the curve repertoire having to satisfy the following conditions;

the direction of curvature of the curve, which is determined from the extrapolation, must correspond to that of p

and

the quotient Q_k of numerator (= if necessary weighted mean of the distance squares between measurement values and extrapolation curve) and denominator (= mean square of the y value range of the extrapolation curve in the area of the data window) must be minimal:

$$Q_k = f(k) = \frac{\sum w_i*(y_i(x_i) - f_k(x_i))^2}{y^2_{mitt_k} * \sum w_i} = \min \quad (i = 1 \ldots \min)$$

where k is a numerator of the available extrapolation curve types (curve repertoire)

in particular $y^2 mitt_k = [(ymax_k + ymin_k)/2]^2$,

with $Y_i(x_i)$ being the measurement value at point x_i,

with $f_k(x_i)$ being the function value of the kth extrapolation curve type at point x_i,

with w_i being a weighting factor for each individual measurement value or for all measurement values of a segment;

so that the continuity (S) is calculated as follows:

$$S = \frac{\sum \gamma_i * (C_i - O_i)^2}{\sum \gamma_i};$$

with i = 1…3 being the numbering for the segment areas, with γ_I: weighting factors 1…n, with O_1 to O_3 being the gradients of the selected kth curve (36, 39, 42) for the extrapolation in respect of each half segment width, and with C_1 to C_3 being the gradients of the linear segment adjustments.

12. Method according to Claim 1, characterized in that the x uncertainty is defined as follows: selection of an extrapolation function, which can be transferred to linear structures, i.e. a selection is made at least from the group

Linear function	-> $y = a_0 + a_1 * x$
Potency function	-> $\ln y = \ln a_0 + a_1 * \ln x$
Logarithmic function	-> $y = a_0 + a_1 * \ln x$
Exponential function	-> $\ln y = \ln a_0 + a_1 * x$,

determination of a database (6), with the database (6) comprising n correlated x and y values Calculation of $\bar{x}$ and $\bar{y}$ of the database 6 and the variable $\sum x_i y_i$

Calculation of $S_{xy} = \frac{1}{n-1}\left(\sum x_i y_i - \overline{nxy}\right)$ (i = 1…n)

Calculation of $S_{x^2} = \frac{1}{n-1}\left(\sum x_i - \bar{x}\right)^2$ (i = 1…n)

Calculation of $S_{y^2} = \frac{1}{n-1}\left(\sum y_i - \bar{y}\right)^2$ (i = 1…n)

Calculation of a gradient $b = \frac{S_{xy}}{S_x^2}$

Calculation of $a = (n-1)\left(s_y^2 - b^2 s_x^2\right)$

Determination of an equation for a regression line

$y = \bar{y} + b(x - \bar{x})$

with a confidence factor γ, a variable F (c) is calculated

$F(c) = \frac{1}{2}(1+\gamma)$,

with F(c) and n-2 (n = number of measurement values) degrees of freedom, the t-distribution (student distribution) gives a value c,

Determination of Δm

$$\frac{c\sqrt{a}}{S_x\sqrt{(n-1)(n-2)}}$$

which gives an uncertainty of the gradient m:

$b - \Delta m \leq m \leq b + \Delta m$,

Determination of the straight line equations (27, 21) with the gradients $b - \Delta m$, $b + \Delta m$,

Determination of the points of intersection (I_{min}, constant) and (I_{max}, constant) of the straight line with a parallel (18) (y = constant),

which corresponds to a limit value (18),

Determination of corresponding x values I_{max} and I_{min},

where $I_{max} > I_{min}$,

Calculation of $\Delta I = I_{max} - I_{min}$

13. Method according to Claim 11, characterized in that the value range of continuity (S) is in the range 0 and + ∞.

14. Method according to Claim 1, characterized in that the measure of quality (K) changes over time and that an evaluation of the time variance of the extent of extrapolation (c) is calculated as follows:

$$C = \frac{\sum \gamma_i * (K(t_i) - q(t))^2}{q^2_{mitt_K} * \sum \gamma_i}$$

with i being the number of iterations,

$q^2 mitt_K = [(qmax_K + qmin_K)/2]^2$

with γ_i being a weighting factor.